In a second embodiment, the apparatus of the invention has a receptacle on at least one of the first and second arms. A suture stay is removably mounted to the receptacle, thus allowing sutures for pericardial retraction or for other purposes to be positioned in the suture stay and retained therein during a procedure. Preferably, the suture stay is plastic or other disposable material, allowing the suture stay to be removed from the receptacle and discarded after use. Usually, the suture stay will accomodate a plurality of individual sutures, and/or the arms include a plurality of receptacles to accomodate multiple suture stays. In an exemplary embodiment, the receptacle comprises a cavity in the arm adapted to receive the suture stay. A retention mechanism is provided on the suture stay and/or on the arm to releasably retain the suture stay in the cavity.

The suture stay preferably comprises a body having an inner edge and an outer edge and retention structure on the body for retaining the body on a blade of the surgical retractor. At least one channel extends through the body from the inner edge to the outer edge and is adapted to removably receive a suture therein. Additionally, a clamp is coupled to the body adjacent to the channel and is adapted to releasably retain the suture in the channel. Usually, the suture stay will be placed in a bag, pouch or other container and sterilized separately from the arms and other components of the apparatus.

In a further embodiment, an apparatus for performing surgery on a heart of a patient comprises a rack, a first arm and a second arm mounted to the rack, the first arm being movable relative to the rack and relative to the second arm. A first blade is mounted to the first arm and a second blade is mounted to the second arm, the first and second blades having first and second surfaces facing away from each other, the first and second surfaces being adapted to atraumatically engage tissue or bone for the retraction thereof. A first rail is disposed on the first arm, a second rail is disposed on the second arm, and a third rail is disposed on the rack. The apparatus further includes a stabilizer adapted to be coupled to any one of the first rail, second rail or third rail, the stabilizer having a foot, the foot being configured to atraumatically engage the surface of the heart.

The invention further provides a stabilizing device for stabilizing a site on an outer surface of a patient's heart to facilitate surgery thereon. In one embodiment, the stabilizing device comprises a shaft, a foot coupled to the shaft having a contact

surface for atraumatically engaging the outer surface of the heart, and a mount having a first coupling for attachment to a chest retractor, a second coupling for attachment to the shaft, a first movable joint interconnected between the first and second couplings, and a second movable joint interconnected between the first joint and the second coupling. Preferably, each of the first and second joints is movable about at least two axes of rotation. For example, the first and second joints may comprise spherical joints or ball-in-socket joints. In one embodiment, the first joint comprises a first hemispherical member centered on a first axis and the second joint comprises a second hemispherical member centered on a second axis, the first and second axes being non-parallel, and preferably being generally perpendicular.

A further understanding of the nature and advantages of the invention may be realized by reference to the remaining portion of the specification and the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a retraction and stabilization system according to the invention.

Fig. 2 is a partial perspective view of a retractor in the system of Figure 1 showing a back side thereof.

Fig. 3 is an assembly view of a stationary arm and a movable arm in the system of Figure 1.

Figs. 4A-B are top perspective and bottom perspective views, respectively, of a suture stay in the system of Figure 1.

Fig. 5 is a perspective view of a stabilizer and mounting base mounted to an arm in the system of Figure 1.

Figs. 6-8 are front, side and top views, respectively, of the stabilizer and mounting base of Figure 5.

Fig. 9 is a side cross-section through the mounting base of Figure 5.

Fig. 10 is a front cross-section through the mounting base of Figure 5.

Fig. 11 is a perspective view of the system of Figure 1 in position in an incision in a patient's chest.

Fig. 12A is a prespective views of a further embodiment of a stabilizer according to the invention.

Fig. 12B is a perspective assembly view of a distal portion of the stabilizer of Fig. 12A.

Fig. 13 is a perspective view of a stabilizer and blower according to the invention.

Figs. 14A-C are perspective, top and side views, respectively, of a heart retractor according to the invention.

Figs. 15A-15B are perspective and side views, respectively, of a vascular clamp holder according to the invention.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

A system for performing cardiac surgery according to the invention includes a retractor for retraction of a sternotomy or thorocotomy. The retractor has a pair of arms movable toward and away from each other and a pair of blades mounted to the arms which may be placed in a chest incision. The blades have contact surfaces facing away from each other which engage the opposing sides of the incision to allow retraction thereof. The arms preferably are mounted to a rack having a plurality of teeth, and at least one of the arms has a pinion gear which engages the teeth on the rack to facilitate movement of one arm relative to the other. In other embodiments, a cable-drive mechanism may be used rather than a rack and pinion, or the arms may be mounted directly to each other or to a third member by a rotational joint.

In a preferred embodiment, a rail is disposed on each arm of the retractor, and, if the two arms are connected to a rack, a rail is also disposed on the rack. Various accessory components may be coupled to the rails, including heart stabilizers, heart retractors and manipulators, CO_2 blowers, irrigators, suction devices, vascular clamps, lighting devices, catheters, and other devices. The rails are configured to allow slidable movement of such accessories components along the arms to a selected position.

The system of the invention will further include a stabilizer for stabilizing a surface of the heart. The stabilizer mounts to the retractor at any of various locations, preferably to one of the rails on the arms or rack of the retractor. The stabilizer includes a shaft and a foot, the foot being configured to atraumatically engage the surface of the heart to stabilize the surface while the heart is beating. The foot may have various configurations, including a bifurcated fork, partial or complete ring, or